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A farming system modelling (FSM) approach linked to a farming system reference monitoring network (FSRMN) to assist in decision making processes for development projects supporting Direct seeding, Mulch-based Cropping systems (DMC) in Madagascar.

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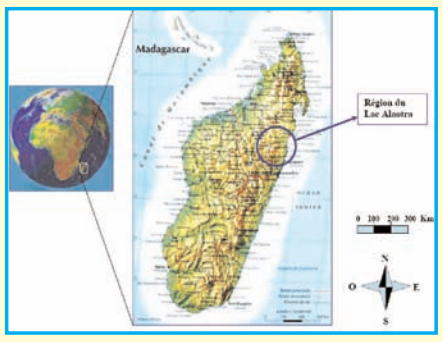
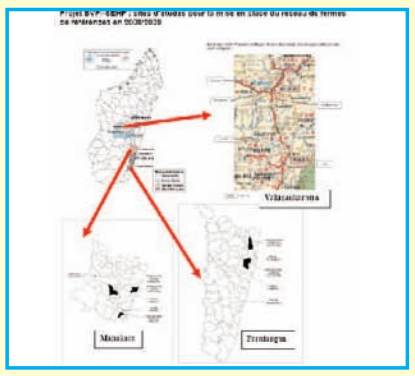
The right modelling tool fo the right use

In the past, methods were developed for farming system couselling (Attonaty et al, 1992, 1999). Today, several different stakeholders involved have different interests. The aim is not to find THE optimal solution as do models based on linear programming (Rieu et al., 1994) or game theory (Thoyer et al., 2001) but to create models that lead to acceptable compromises between the different stakeholders.





Two agricultural development projects are currently implemented in Madagascar taking into account both a watershed approach and a farming system approach for dissemination:
- BV-lac in the area of LAKE ALAOTRA and
- BVPI in Vakinankaratra (Central highlands) and South-East.

A **farming systems reference monitoring network (FSRMN)** has been set up since 2007 for the attainment of two objectives:

i) to help the project in decision making processes for choosing appropriate technologies that will be developed according to a farmer's typology using prospective analysis,
ii) to monitor the project's economical impact in the short and medium term.

A farming system modelling approach using software developed by INRA-CIRAD-IAMM ("Olympe", JM Attonaty, INRA), is used to select the best adapted technologies for farmers' conditions including DMC.
The approach is based on partnership, farming system analysis, and modelling for a **Decision Support Systems** (DSS) project orientation.

This poster presents the methodology and the tools. FSRMN and farming system modelling (FSM) among other tools include a partnership approach that leads to identification of innovation processes and adoption and/or adaptation of DMC systems by farmers in order to understand farmers' strategies and to adapt technologies to farmers' situations. The model provides economic results displaying real income evolution and impact on farming practices, labour and organizational changes (credit …).
FSRMN and FSM have been so far well adopted as tools at project levels to cope with the best combination between farmers' needs and the projects' proposals for DMC techniques.

Definition of DMC (direct seeding mulch-based cropping systems : SCV in French)

DMc are based on 3 principles: i) Continuous minimum mechanical soil disturbance, ii) Permanent organic soil cover, iii) Diversified crop rotations in the case of annual crops or plant associations in case of perennial crops. The permanent cover can come from i) ex situ mulch, ii) insitu produced mulch, iii) in situ live mulch iv) in situ residual mulch.

The suppression of ploughing creates an environment favourable to the development of the biological ground activity, prevents the development of weeds, limits evaporation, limits runoff. The sharp cover allows a physical soil reorganization via its root system and plays the role of a biological pump: just as in the agroforestry systems. No tillage and limited weeds decrease labour requirements and increase return to labour.

A budget oriented farming system modelling tool : the software "Olympe".

Olympe is based on the systemic analysis of farming systems :

- To identify smallholders' constraints and opportunities in a rapidly changing environment.
- To understand farmers' strategies, decision-making proces and their capacity for innovation (adaptation to changing economic conditions, price crises and technological change).
- To undertake prospective analysis and build scenarios based on climatic risks, major climatic events such as "El Nino years" and fluctuating commodity prices.

It is possible to build several scenarios as a function of changing prices, climatic events and different types of risks.

Risk assessment through prospective analysis

Prospective analysis allow identification of potential farm trajectory. It provides an assessment of the impact of a technical choice, the robustness of farming systems as a function of fluctuations in commodity prices or of climatic risks (definition of "thresholds" for risks, profitability and viable alternatives).
The scenarios have to be defined as a function of real possibilities (Historical records, prices, agrarian history...).
The prospective analysis is used for the following purposes:

- to test the impact of price volatility of commodities or inputs;
- to test cropping and farming systems resilience.
- to assess the impact of farmers' strategic changes on the structure of farming systems and income;
- to assess the impact of climatic events and reduce risks;
- to measure capital/credit requirement to fund any technical change (intensification or diversification..)
- to measure input and output flows;
- to assess the impact of any decision on profitability, returns to labour and returns to investment.

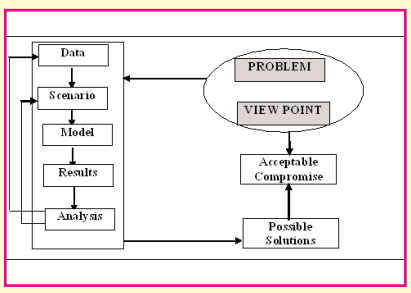
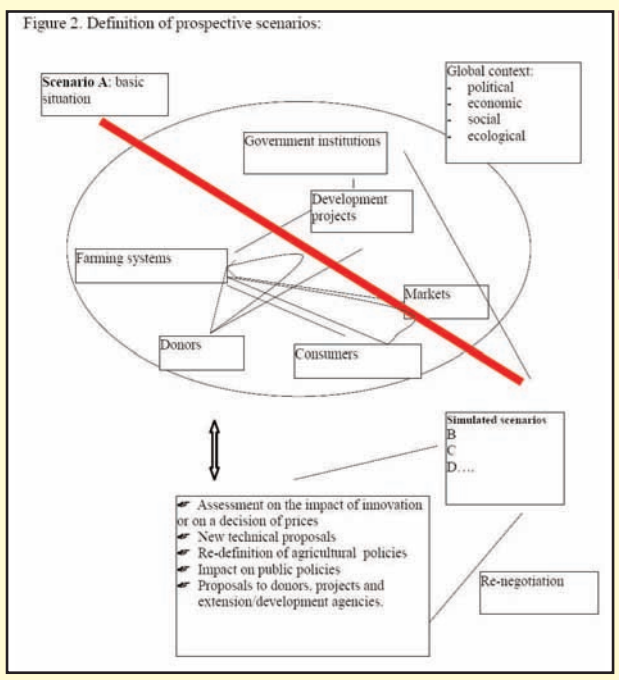


Figure 2. Definition of prospective scenarios:



OLYMPE : A prospective tool to assess the resilience of systems in the face of risk

Focus is on providing decision-making aid to administrators, projects, and decision makers as well as to farmers themselves. Analysis of climatic events or impact of price volatility enable to explore farming systels resilience.
Care needs to be taken into account for the possible or induced perverse effects of "playing with scenarios" whose only validity is how representative they arer. The "revealing character" of FSM leads to enhanced sensitivity by stakeholders to problems that are not initially obvious.

TYPES	rice regarding paddy field type	Criteria 2 : diversification	manpower or off-farm activities
A : great rice producer	Irrigated paddy field (5 ha) Self sufficient for rice + selling	Upland field (tanety) (> 4 ha) From low to no cultivation rate Extensive crops	Use of external manpower > 300 of human labour
B : rice producer with irregular yield	Poor control of paddy fields, RMME Self sufficient for rice + sales	Upland field (tanety) + alluvial field (baiboho): 2-3 ha, entirely cultivated Average intensification Cash crops	Use of external manpower > 200 days of human labour
C : self sufficient rice producer cultivating tanety	Irrigated paddy fields + Poor control paddy fields (2ha) Average risk Self sufficient for rice	Upland field (tanety) + alluvial field (baiboho) : 3 ha, entirely cultivated Intensive cash crops	Use of external manpower = 100 days of human labour Off farm activity= services
D : farmers who diversify their production	Poor control paddy fields, (1.5 ha) heavy risk Not self-sufficient for rice every year	Upland field (tanety) + alluvial field (baiboho) :1 to 2 ha, : entirely cultivated Cash crops Breeding	Use of external manpower = 100 days of human labour If area < 1 ha => off farm work
E : non self-sufficient, farm worker	Few or no paddy fields Heavy risk Not self-sufficient for rice	Upland field (tanety) + alluvial field (baiboho) < 1 ha : Very intensive cash crop	Use of external manpower = 0 days of human labour Off farm activity = farm worker
F : fisherman who cultivates	Poor control paddy fields (1 ha) Not self-sufficient for rice	Upland field (tanety) + alluvial field (baiboho) < 0.5 ha : Intensive cash crops	Use of external manpower = 0 days of human labour Off farm activity = fishing
G : landless	Landless Not self-sufficient for rice	Landless	Off farm activity = farm worker

Source : Stefanie Nave et Claire Durand, 2007, revu Penot et BV-lac : 2008.

The References Farming System Monitoring Network (RFSMN): a comprehension tool of farmers' strategies and follow-up evaluation.

A Reference Farming System Monitoring Network (RFSMN) is a set of representative farms that show various agricultural situations dependent on morpho-pedological and climatic units as well as socio-economical situations, resulting from a typology. Farms are surveyed in-depth then followed and updated every year in order to measure i) the impact of the projects' implementations, ii) the development policies in progress, iii) the resulting innovations' processes.
The objective through a follow-up is to measure the impact, the evaluation, the prospective analysis and decision-making process inside projects (choice of technologies to be promoted and level of intensification according to farm types for example…). A prospective analysis allows the comparison between potential scenarios and reality. The final objective is to allow development operators in contract with

Diversification and DMC for sustainable development

The sustainability of agriculture is a major concern. "Ecological sustainability" is linked with degraded environment and fragile soils and thus fertility, biodiversity, and the protection of watersheds. Crop diversification and technical change characterise the evolution of existing farming systems. It seems crucial to understand key factors of the history of innovations and innovation processes to be in a position to release viable recommendations for development. Among other technologies, DMC triggers a real change of paradigm for farmers. Though yields might not be significantly above that of traditional intensive tillage systems, DMC provide a more sustainable production pattern through the climatic buffer effect of mulching.